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DEVELOPMENT OF A PLANTATION OF HIGH QUALITY TRUE FIR CHRISTMAS TREES

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Prepared by Bernard S. Douglass, U. S. Forest Service, Division of State and Private Forestry, and Gary H. Sander, Extension Forester, Oregon State University, with guidance and assistance of: Oregon State Board of Forestry; Wash. Department of Natural Resources; Oregon & Washington Extension Services; U. S. Soil Conservation Service; Forest School faculties of Oregon State University; University of Washington, and Washington State University; and member growers Northwest Christmas Tree Association.



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DEVELOPMENT OF A PLANTATION
OF HIGH QUALITY TRUE FIR CHRISTMAS TREES

A. INTRODUCTION

All native species of true firs (genus *Abies*) are used for Christmas trees. Some are used to a much greater extent than others, as shown in the following tabulation of trees harvested in 1964:

Christmas Tree	:	:	:	:
Species	:	Oregon	:	Washington
True firs	Number	Percent	Number	Percent
Noble fir	124,000	18.0	12,800	0.5
Concolor fir	78,000	11.0	200	*
Grand fir	39,000	5.0	15,300	0.6
Shasta red fir	4,000	0.5	200	*
Silver fir	3,000	0.4	12,000	0.5
Alpine fir	1,000	0.1	500	*
Total (True Firs)	249,000	35.0	41,000	1.6
Other Species	461,000	65.0	2,409,000	98.4
Total (All Species)	710,000	100.0	2,450,000	100.0

*Less than 0.1%

True firs have several natural advantages for Christmas trees:

1. Their natural beauty as Christmas trees is generally considered unsurpassed.

2. They have strong, sturdy branches that hold their shape.

3. Most true firs retain their needles and freshness.

4. They bring the highest market prices.

True firs also have several natural disadvantages:

1. They are less adaptable to various climates, exposures, and soils.

2. They develop slower than Douglas-fir and pines, especially during first 3 or 4 years after planting.

3. Insects, diseases, and climatic injuries may be troublesome.

4. They are difficult to control for proper growth rates.

5. They fail to respond as well to shearing as Douglas-firs and pines.

More than 90% of true fir Christmas tree production was from natural stands in 1964. However, the acreage of plantation true firs has increased rapidly in recent years. This trend is expected to continue.

Relatively few growers, to date, have produced high quality marketable true fir Christmas trees on plantations. Frequent failures have been caused by poor selection of plantation sites, inadequate site preparation for planting, poor choice of species and seed origins, too small planting stock, and unskilled cultural practices.

The purpose of this bulletin is to help growers avoid some of the pitfalls that have caused past failures. At the same time, it will point out conditions and practices that have produced high quality trees on the relatively few successful true fir plantations.

B. RECOMMENDED TRUE FIR SPECIES

Six species of true fir are natives of the Pacific Northwest. Some 40 other species are widely scattered through North and Central America, Europe, Asia, and North Africa. The best prospects for Christmas tree plantations in Oregon and Washington are four of the native species: noble fir (*Abies procera*), Shasta red fir (*Abies magnifica*) grand fir (*Abies grandis*), and concolor or white fir (*Abies concolor*).

Silver fir has never done well on low-land plantations. Alpine fir seedlings are difficult to procure and need further testing.

Too little is known about the exotic species to recommend planting them except on a limited trial basis.

Noble and Shasta red firs will be grouped together for this discussion because their appearance, cultural responses, and site preferences are quite similar. Concolor and grand fir will be grouped together for the same reasons.

1. Noble and Shasta Red Firs.

Noble and Shasta red firs grow naturally at 2,500- to 5,000-foot elevations.

Branch and needle structure is stiff and strong to withstand heavy snows in their natural habitat. They have characteristic well-branched whorls with rather short internodal branches and open internodal spaces between. Their greatest beauty is stately appearance provided by a formal uniform branching habit. They are easily decorated with pendulant type Christmas tree ornaments, such as colored glass balls and tinsel.

They are also adaptable to flocking with artificial snow.

Noble fir is a native of the high Cascades and Coast Ranges from northern Washington to southern Oregon. Shasta red fir is a native of the high Cascades and Siskiyou Mountains of southern Oregon and northern California. Shasta red fir is known as the "silvertip" on the California Christmas tree market.

Both species have produced beautiful, desirable plantation-grown Christmas trees when grown on suitable sites and properly cultured. Needle retention and durability during storage and shipping is outstanding. Their appearance is quite similar. Where one species grows well the other is also likely to succeed. Noble fir usually grows slightly faster than Shasta red fir, but Shasta red fir is somewhat more tolerant of dry soil conditions. Growers with suitable planting sites should, perhaps, try both species and give future preference to the one that responds best.

Noble and Shasta red fir are very particular about their growing site. They prefer level to gentle northerly and easterly slopes where soil is rich in humus, moist and well drained. They do not tolerate heavy compacted clay soil, heavy grass sod, or frost pockets. Cool moist conditions preferred by these species do not imply overhead shade. Like all other Christmas tree species, they develop best under open sunlight without root competition from larger trees, brush, grass, and weeds.

2. Concolor and Grand Firs.

Concolor fir grows naturally on level to northerly and easterly exposures in the mountains of southeastern Oregon. Its range extends down the west slopes of the Cascades to a limited extent in southern Oregon. It also has a wide range outside the Pacific Northwest in California, the central and southern Rockies, and Mexico.

Grand fir grows naturally in western and eastern Washington, and western and northeastern Oregon at many elevations. It is also found in southern British Columbia, northwestern California, southern Idaho, and western Montana. Concolor fir and grand fir, like Douglas-fir, have many inherited variations over their wide geographic ranges. These include differences in growth rate, disease resistance, color, needle retention, and many other characteristics that are important to Christmas tree growers. For example, the needles of the southern Rocky Mountain strains of concolor usually have a blue-green tint and relatively good retention when the trees are cut. Trees of Oregon and California strains are lighter green and sometimes have a problem of shedding needles. Also, west side strains of grand fir usually have needles arranged in two single flat rows on the twig. Many east side strains have two double rows on each twig and the needles sometimes spread upward somewhat like noble fir.

Both concolor and grand fir produce beautiful Christmas trees. They are usually priced on the Christmas tree market between noble fir and Douglas-fir. Concolor fir generally has a somewhat bushier appearance than grand fir because its needles are longer and point out in many directions from the twig.

Some west side plantations of concolor and grand fir have become heavily infected by rusts and other foliar diseases in recent years. Resulting discolorations and shedding of needles have hurt their value for Christmas trees. Some plantation managers have become discouraged from further planting of these species or have switched over to noble and Shasta red firs. Other west side growers have apparently found a favorable combination of site and seed source to produce vigorous, well-formed, disease-resistant trees. Research is being carried out for concolor and grand fir Christmas trees particularly the relationship of seed origins to tree quality and disease resistance.

Meanwhile, west side growers are advised to establish these species sparingly on each planting area and carefully observe their growth, form, and disease resistance before attempting larger plantings.

C. MATCHING SPECIES TO SITE

The high elevation true firs, noble and Shasta, require more moisture and cooler growing conditions than grand fir, concolor fir, Douglas-fir and pines. At the same time, they require good drainage. Best growth response in plantations is usually obtained on level to gently sloping northerly to easterly exposures where the soil is well drained but not subject to severe summer heat and drought. However, their ability to survive on southerly and westerly exposures improves where summer rainfall is heavy and summer temperatures are moderate. This may explain why noble fir and Shasta red fir usually respond best when planted at higher elevation plantations that approach their natural range. Experience has shown that their chances for survival and growth response are likely to be better on a foothill field at 1,500-foot elevation than on a lowland field only a few miles away.

Concolor and grand firs require greater summer moisture and coolness than Douglas-fir or pine. However, they are less demanding in this respect than noble fir and Shasta red fir. They appear to respond equally well on high or low elevation plantations, but prefer cooler,moister sites. Level to gently sloping northerly and easterly exposures are usually most favorable in these respects for low elevation plantations.

Christmas tree growers sometimes have several site conditions on a single planting area. For example, a ridge running east and west through a field contains both north and south exposures. The north exposure is usually the best choice for planting true fir Christmas trees, but usually the poorest for Douglas-firs and pines. A good topographical planning map will help the grower decide the best species to plant on each portion of his planting area.

Opportunities to establish true fir plantations east of the Cascades are limited by excessive heat and dryness. Grand fir and concolor fir are the most reliable east side true fir species. Best chances for survival are on northerly to easterly exposures where these species grow, or once grew, naturally. Planting moisture-loving species such as noble fir and Shasta fir on dry east side sites is a waste of time and money.

D. PLANTING

Planted true fir seedlings require sunlight and adequate moisture. They should always be planted on bare, freshly cultivated ground. Fields infested with quack grass, Canada thistle, or bracken fern should be avoided until these have been eliminated. Rank growth of grass and weeds during the spring and summer months will shade and distort the newly planted seedlings and deplete moisture in the soil. Old fields with heavy sod or weed cover should be disked as often as necessary during the summer to control grass and weeds; then disked and harrowed during the following spring just before planting. This will cause sod and other heavy organic matter to break down and decay. It will also eliminate new growth from seeds and root sprouts.

Three- or four-year-old true fir planting stock (2-1, 3-0, 3-1, or 2-2) is recommended. Its extra cost over two-year-old seedlings is justified by more rapid development and decreased first year's mortality in the plantation. Any runty or weak seedlings should be sorted out before planting. These can be developed into vigorous seedlings in a transplant bed. They provide a handy source of seedlings to replace mortality in the field. Transplant beds may also be used to develop 2-0 seedlings to larger stock for next year's planting.

Planting stock is packed in tight bundles or packed in waterproof bags at the nursery for convenience during shipment. Wet shingle tow, moss, or other

absorbent material is placed around the roots to protect them from drying. Water should be poured through both ends of bundles as soon as they arrive to replenish water lost during shipment. Bundles should be stored outdoors in a cool, protected spot. Unless trees are planted within about a week after delivery, they should be removed from the bundle and heeled in where there is sufficient moisture, shade, and protection from drying winds.

Planting, whether by hand or machine, requires special techniques for good survival. A farm forester or other local forester should be consulted.

Whether to spring plant or fall plant depends on when planting stock is available and frost heaving conditions, which may occur when trees are fall planted on heavy clay-loam soils. Consult your local forester.

A 5x5 foot spacing is commonly used for producing true fir Christmas trees 5 to 7 feet tall. Some growers prefer somewhat wider spacing-- $5\frac{1}{4}' \times 5\frac{1}{4}'$ or $5\frac{1}{2}' \times 5\frac{1}{2}'$ --to permit easier operation of their equipment between the rows or to provide more open sunlight around the lower branches.

Perfect spacing of trees to form check rows in each direction has the advantage of permitting cultivation and mowing in two directions. However, many growers do not believe the additional cost of check row planting is justified. They prefer, instead, to space the trees randomly in straight rows, and rely on chemicals to control grass and weeds. When check rowing is the preferred method, it can be accomplished by pre-marking the cultivated field in squares or hand planting along a wire marked at proper intervals. Machine planting is much faster and somewhat less costly than hand planting, but few operators have acquired sufficient skill to plant accurate check rows.

Roadways are needed through the plantation to provide access and fire protection. These can be provided by skipping the planting of two adjacent rows of trees at intervals of every 20 to 30 rows.

E. WEED AND GRASS CONTROL

True fir Christmas tree plantations should be kept free of heavy grass and weeds. This is especially important for survival and growth during the first three or four years after planting. Weed and grass competition harms the trees in three ways:

1. It forms a canopy of shade that suppresses and deforms the trees. Trees need open sunlight for adequate growth and attractive needles.
2. It depletes moisture and nitrogen from the soil. True firs require adequate summer moisture and nitrogen for good growth, color, and survival.
3. It provides a habitat for meadow mice, gophers, rabbits, and other destructive rodents.

Frequent cultivation for the first three or four years after planting was, until recent years, the best known practice for controlling grass and weeds. Chemical herbicides, particularly atrazine, are now rapidly replacing cultivation for doing this job. They usually prove less costly, more effective, and longer lasting than cultivation. Moreover, they permit vegetation control around the base of the trees where cultivation is difficult.

Atrazine is available in either dry granular form or as a wettable powder. The wettable form is least costly. Both forms are effective as a combination pre-emergent (kills grass and weed sprouts as they germinate), and post-emergent (kills existing cover of grass and weeds). However, it is relatively ineffective for bracken fern, Canada thistle, and other deep-rooted vegetation.

It should be applied uniformly over newly planted areas in February or March before new sprouts have emerged. It should be re-applied at the same season about every two years, or whenever grass and weeds become re-established. Atrazine can be applied directly over dormant trees, even those that are newly planted, without causing damage. In fact, trees metabolize this chemical and actually show improved color and growth after its application.

Usual rates of applications are about three pounds per acre (actual) on sandy or gravelly soils and about four pounds per acre on heavier clay-loam soils. The granular form is usually applied by hand spreading or with power blowers; the wettable form by aerial spraying, boom sprayers with agitators, or hand sprayers on small areas. Some growers save chemicals by spot-treating three-foot circles around individual trees; then mowing the intervening grass strips. However, broadcasting the entire area will usually save time and money in the long run. Detailed instructions for use of herbicides should be obtained from your local farm forester or county agent.

Mowing, chemicals, or a combination of mowing and chemicals, is the usual method of weed and grass control after the third or fourth growing season. If continual cultivation is the preferred method, the equipment must be small enough and the bottom tree whorls developed high enough above the ground to prevent mechanical injuries to the branches.

F. INSECT AND DISEASE CONTROL

1. Insects have not been particularly troublesome on most true fir Christmas tree plantations. However, balsam woolly and other aphids, budworms, needle miners, and sawflies are all potential problems. It is more effective and less costly to spray with insecticides at the very first outbreak than to wait until the plantation is badly infected.

White grubs of the June beetle sometimes devour roots of seedlings planted in old fields. An effective preventative treatment is to starve out the white grubs by clean cultivating the field for a year before planting.

County agents, farm foresters, and forest entomologists can help to identify insects and recommend effective insecticide treatments.

2. Diseases have been a serious problem on many west side true fir plantations, particularly on grand fir and concolor fir. Most serious are several types of true fir needle rusts, which cause spore blisters on the undersides of the needles, followed by browning and shedding from the twig. The most serious rust, *Uredinopsis pteridis*, alternately infects bracken fern. Huckleberry is an alternate host for another common species of true fir needle rust.



The first indication of needle rust is white spore blisters on the undersides of the needles in spring and summer.

Two species of true fir needle cast fungi may cause black lines and spots on the needles, followed by browning and shedding.



Rust infection is followed by browning and shedding of needles during late summer and fall.

County agents, farm foresters, and forest pathologists can help to identify tree diseases and recommend effective fungicide treatments. Like insects, diseases are easiest to stamp out in their earlier stages before they gain a foothold.

G. DESCRIPTIONS OF CULTURAL PRACTICES

Several effective cultural practices for controlling growth and improving quality of true firs will be described in this section.

Excessive leader growth can be controlled by shock treatments such as basal pruning, basal scarring, and root pruning. Growers should strive to hold annual leader growth to 10" - 14" by using one or more of these methods when needed. Trees that grow faster than this will have a spindly appearance caused by widely spaced branch whorls. However, trees should be shocked only enough to accomplish the desired slowing of growth. Overshocked trees become stunted and may develop unthrifty needles. Unlike pines, which the grower can shear each year to any desired shape, true firs require "good guessing" on the part of the grower as to the correct

degree of shocking. Experienced growers develop an almost uncanny ability to prejudge the amount of shock required to hold growth to the desired rate. Their principal indicator is the growth rate during the past two years. For example, if a noble fir grew 10 inches two years ago, and 14 inches last year it is almost certain that it may grow 18 inches or more the next year. The tree should be shocked to prevent this excessive growth. On the other hand, if a tree has been growing uniformly at 12 inches per year for the past several years, it is less likely to make a sudden and spectacular gain during the next growing season.

Some trees will "get away" by developing excessively long leaders despite preventive shock treatments. The trees should be restored to proper proportion by leader pruning and side shearing. These treatments will usually produce a marketable tree that would otherwise be a cull. However, true firs that have been leader pruned and sheared are usually not as high in quality as unsheared trees with adequate whorl spacing.

Additional cultural practices will be described for replacing lost leaders, developing new trees from a stump, and fertilizing to improve quality. Growers should not be surprised that each tree in their plantations shows somewhat different growth habits. Each tree should be cultured individually to bring out its best qualities. Some trees may develop into premium quality by only basal pruning. Others, growing on the same site, may require a number of different cultural treatments to make them marketable. A few trees will fail to shape up regardless of how skillfully they are cultured. In the long run, each plantation manager must go through a process of trial and error and adopt the cultural practices that produce the highest quality for him.

1. Basal Pruning. Locate a good bottom whorl with at least four, and preferably 5 or more strong, evenly spaced branches. This bottom whorl should not be lower on the stem than 13 - 15 inches above the ground. This minimum height permits an adequate handle plus several additional inches of stem below the handle for scarring and possibly stump culturing. In practice, the bottom whorl of many trees will be located more than 15" above the ground. This may be necessary to find a good bottom whorl, locate a straight stem for the handle, or develop the lower branches above heavy shade caused by grass and weeds. Basal pruning should eventually remove all unwanted branches below the bottom whorl. They should be cut flush with the bark. If stump culture is planned, a few branches should be retained below the base of the handle near the ground to keep the stump alive after the tree is cut. Basal pruning can be done any time of the year except early summer at which time tender new growth is easily damaged during culturing.

Basal pruning retards tree growth by shocking the tree. A growth control study for noble fir ¹/shows height growth retardation of 21% during the first growing season after removing 50% of the live branches by basal pruning. Growth retardation was even more--25%--during the second growing season, and continued to a lesser degree into the third growing season after treatment. Thus, basal pruning can be used as an effective shock treatment to help prevent future excessive leader growth. At the same time, excessive shock from overpruning should be avoided by deferring basal pruning until such time that it appears that next season's growth would likely exceed 12" unless the tree is shocked.

¹/Study made in Clackamas County, Oregon, by Bernard Douglass, Alvin Parker, Clayton Wills, and Harry Roundsfell 1961 - 1963.



This grand fir grades below U.S. No. 2 because of excessive whorl spacing. Basal pruning to reduce growth rate could have resulted in a U.S. Premium or U.S. No. 1.



Basal pruning is one of the most useful cultural practices. It is used to shock the tree to prevent excessive future growth. It also forms a handle under a strong, uniform whorl to become the base of the planned tree.



This noble fir is not ready for basal pruning. Annual growth is less than 12" per year. Premature shocking would cause further stunting and delay its harvest by several years.



This noble fir is ready for basal pruning as indicated by the 14" leader. If the tree is not shocked at this time, next year's leader is likely to grow excessively long.



Basal pruning during the previous year effectively controlled growth of this noble fir. Had the tree not been shocked, indications are that the leader would have been about 18" long instead of 13".

2. Shearing. Shearing consists of removing unwanted tips of individual lateral branches to improve symmetry, taper, and density. Shearing is not recommended for true firs that shape up well naturally. Most customers prefer true firs that appear natural and un-sheared with uniformly spaced whorls, symmetric shape, and moderate density. Growers should endeavor to produce such trees by controlling the growth rate of naturally shaped trees, rather than by correcting trees after they have already made excessive growth.

However, many true firs will need shearing in spite of growth control measures because of excessive leader growth, lop-sidedness, faulty cone shape, or loss of leader buds. Many unmarketable type trees can be restored by timely shearing.

The only type of shearing recommended for noble fir and Shasta red fir is "fork shearing". This consists of

removing tips of individual lateral branches with a hand pruner just above a fork in the branch formed by oppositely arranged secondary branches. Sufficient branch tip should be removed to attain desired tree width and uniform cone-shape. Fork shearing does not cause noticeable stubs and it develops symmetrically formed branch tips. Several years' growth may need to be removed from excessively wide trees to restore a normal taper. One disadvantage of fork shearing should be recognized. Heavy snowfall or rough handling may cause limb breakage at the point of the forks.



Fork shearing removes individual lateral branch tips to improve shape and prevent excessively wide trees. New growth from secondary branches is symmetrical and fan-shaped.

Grand fir and concolor fir are sometimes random sheared with a shearing knife or hedge shears, rather than fork sheared, to improve density, shape or taper. The best season to random shear is July or August before the new growth has hardened off completely. However, fork shearing is the preferred method because it leaves the branch tips more natural in appearance.

3. Disbudding is accomplished by pinching off the terminal, or middle bud, from the bud cluster at the tip of main lateral branches. Branch growth resulting from disbudding is similar to that of fork shearing. It prevents growth of the main branch tip and allows two or more secondary branches to develop instead. Disbudding is used for the same purpose as fork shearing but is considered a less drastic treatment. A combination of disbudding and fork shearing is frequently used for the same tree when some branch tips require greater shortening than others.



An excessively long concolor fir leader was pruned to proper length a year ago. Pointed out is a typical "dogleg" where an internodal bud just below the cut formed a new leader.

4. Leader Pruning is done to cut back excessively long leaders to proper length. Like shearing, leader pruning of true firs is recommended only as a last resort when natural growth is excessive or lacks adequate density. Ideal annual leader growth for true firs is about 12". However, it is usually

better to retain natural leaders up to about 15" in length than to correct them by pruning back. Reason: The base of the new leader arising from the top bud of a pruned leader usually forms an unsightly crook called a "dogleg". Also, the terminal bud set of this new leader frequently contains only three buds which produce a branch-like whorl. These leader pruning difficulties occur for all species of true firs, but are especially pronounced on noble and Shasta red firs. The difficulties can be minimized by leader pruning during midsummer when new growth is just completed, rather than during the dormant season. This timing allows the terminal bud to become more erect and better adjusted to produce adequate terminal buds the following year.



Pruning excessive leader growth frequently results in poor branch formation. This noble fir top shows this tendency with a one-sided branch arrangement and only 3 branches in the top whorl. Better results can be obtained by controlling natural growth to prevent excessive leader lengths.

Detailed instructions for leader pruning are as follows: Locate a cluster of internodal buds on the leader about

10" - 14" above its base. Locate a strong internodal bud 2" - 4" above the cluster and cut the leader on a 45° slant about ¼" above it. Any additional buds between the cluster and the top bud should be picked off to discourage formation of multiple leaders.

At the same time, it is always necessary to cut back the branch tips of the top whorl just above a pair of buds or a single bud on the bottom side of the branch. Pick off any bud from the top side of a branch within 1" of its sheared tip. Top buds form unsightly "in pointing" branches. Shearing back the branches of the top whorl prevents them from turning up and forming multiple leaders. It also keeps their length proportional to that of the pruned leader. When the leader and top whorl are pruned, it is usually necessary to shear the rest of the tree as well to restore a uniform taper and prevent excessive tree width.



Multiple leaders formed on the pruned top of this grand fir. They were caused by leaving 3 internodal buds, rather than one just below the cut. It is being corrected by removing all of the leaders except the one with the best bud set.

Leader pruning, together with fork shearing and disbudding, increases the density of light, open branched trees. It forces internodal branches to fill in wide growth intervals between whorls, known as "goosenecks".



New leaders arising from internodal buds of pruned noble fir and Shasta red fir leaders are frequently reluctant to turn up straight. A splint or wire is needed to straighten the noble fir leader shown above.

Next year's leaders, arising from the top buds of a pruned leader, do not always grow straight and erect, and may require leader training. An effective method is to make a loose spiral around the bent leader with a 12" - 16" piece of #8 to #13 gauge (depending on leader stiffness) aluminum wire. This permits bending the leader to any desired position. Best season to train leaders is late July and early August when new growth has sufficiently hardened off to resist injury by the wire. The wired leaders will set permanently after about 30 days for grand fir and concolor fir and after about 60 days for noble fir and Shasta red fir. In any event, the wire straightener must be removed before the next growing season to prevent strangulation.

5. Replacing Lost Leaders. Aborting of the center leader bud or mechanical injuries may cause true firs to lose their leaders. When this happens, several branches of the top whorl may turn upward and form multiple leaders. Needless to say, this spoils the symmetrical appearance of the tree.

Caution: Sometimes regrowth (lammas growth) will occur from the terminal bud cluster of a leader in late summer. This causes short branchlets instead of normal buds. Frequently, in this case, the lateral buds of the terminal cluster will elongate, but not the center bud. This makes the center bud appear to be dead. Actually, it is usually alive, and will catch up with the laterals next growing season and make a normal leader.



The center bud of this noble fir aborted leaving a top whorl without a leader. It can be corrected as follows: Select a strong branch in the top whorl. Bend it upward to a vertical position and hold in place with a splint or wire straightener. Cut back the remaining branches in the top whorl to restore good proportion and to prevent them from forming multiple leaders.

A lateral branch can be trained to replace a lost leader by prompt treatment,

preferably in late July or August. A strong, closely spaced lateral branch in the top whorl should be selected for the new leader. It should be bent to a vertical position and held in place with a loose spiral wrapping of aluminum wire or by a splint. When wire is used to train a lateral branch it will need to stay on the tree 2 or 3 months before the branch "sets" in a vertical position and the wire can be removed. At the same time, the tips of the other top whorl branches should be cut back to approximately half the length of the new leader to prevent them from turning up, assure dominance of the new leader, and restore good proportion to the tree.

Sometimes the entire terminal rosette of leader buds aborts or is broken off. In this case the leader should be pruned back as described in (4) on page 11.

6. Basal Scarring. Basal scarring is accomplished by skinning off a strip of bark about 4" long from the base of a tree to produce shock and slow its future growth. The scar should always be made 9" or more below the bottom whorl to avoid disfiguring the handle. Therefore, sufficient stem length below the bottom whorl should be allowed for scarring, as well as for forming a handle.

Scarring should not be done unless excessive growth threatens to become a problem. Its principal purpose is to reduce the growth rate of trees that have recovered from the retarding effects of basal pruning. Scarring is sometimes combined with basal pruning on fast growing trees when growth would not be sufficiently retarded by basal pruning alone.

Light scarring girdles about 1/3 of the stem circumference and heavy scarring girdles a maximum of 3/4. The more severe the scarring, the more pronounced will be next year's growth reduction. Scarring should be only as deep as the cambium layer. Cutting into the wood weakens the stem and does not appreciably increase shock.



Basal scarring is accomplished by removing strips of bark from the main stem below the handle. It is used to further slow the growth rate when basal pruning will not provide the desired degree of shock.

Growth control experiments on noble fir^{1/} (footnote page 8) produced 30% reduction of next year's growth by combining 50% scarring and basal pruning to remove half of the live branches. Basal pruning without the scarring reduced next year's growth only 21%.

Growth control experiments on grand fir^{2/} produced 16% reduction of next year's growth by 50% scarring alone. However, the shock wore off and growth reverted to normal during the second year.

7. Root Pruning. Root pruning is accomplished by cutting a portion of the surface roots of a tree to produce shock and slow growth. Roots are normally cut about 2/3 the distance from the stem to the drip line at a soil depth of about 8". Root pruning should normally be done only on one side or two opposite sides of the tree. A complete circular cut entirely around the stem overshocks the tree and causes yellowing of the needles for at least one year.



A grand fir is being root pruned by cutting the surface roots on two sides of the stem with a sharpened shovel. This tree grew excessively in spite of previous basal pruning and basal scarring. Additional shock is provided to slow future growth.

Root pruning is not normally done unless excessive growth threatens to become a problem despite previous basal pruning and scarring. It is usually reserved as a last resort shock treatment when all other treatments have failed to retard growth sufficiently.

Growth control experiments on grand fir^{1/} (footnote page 8) produced 60% reduction of next year's growth by cutting a circle in the soil entirely around the stem the depth of the shovel blade and 2/3 of the distance from the stem to the drip line. The second year's growth rate reduction was even greater--about 70%.

^{2/} Study made in Clark County, Washington, by Fred Pratt, James Gibbons, and Bernard Douglass 1960 - 1962.

Growth control experiments on noble fir^{1/} (footnote page 8) produced 27% reduction of next year's growth by a less drastic type of root pruning combined with basal pruning to remove half the live branches. Root pruning, in this instance, was by parallel cuts on two sides of the tree the depth of a shovel blade and 2/3 the distance from the stem to the drip line. Growth reduction the second year increased to 36%, but the third year reduction of only 21% indicated recovery from the shock.

8. Stump Culture. Stump culture is the practice of developing a new tree from a small limb or sprout on the stump after a Christmas tree is cut. A year or two after the tree is cut, the sprouts will turn upward and form multiple leaders. The most promising one is then selected to produce a new tree.

Stump culturing is recommended where planted trees are difficult to establish and the established root system of the cut tree will reduce the rotation age of the next crop of trees. It also permits establishment of an uneven aged Christmas tree plantation where Christmas trees may be harvested off the same area year after year.

True firs are reluctant to form a new tree from an upturned branch. Much better results for this species are obtained by developing a newly formed stump sprout.

Sprouting can be encouraged by lopping off the tips of the live branches left on the stump. The only purpose of these branches is to sustain the vigor of the root system until a sprout is produced. A good rule of thumb on the amount of branches necessary to leave on the stump to keep the root system alive is at least 10% of the total live crown of the tree.

The best time to select branches on the lower stem for stump culturing is when the trees are being basal pruned.

Normally, only a partially suppressed whorl next to the ground need be retained. Branches in this whorl will develop greater size and vigor during the period that the Christmas tree is growing to marketable size. It may even be necessary to cut their tips back if they interfere with mowing or cultivating, or grow upward into the lower whorl of the Christmas tree. Sometimes vertical adventitious sprouts form below the handle a year or two before the Christmas tree is harvested. These should be encouraged because they will give the new stump-cultured tree a year or two head start.

9. Fertilizing. Most cleared lands, formerly under cultivation, contain sufficient nutriment for good Christmas tree vigor and color without fertilizing. However, exceptions may occur causing needles to remain chlorotic (yellowish) or growth rates to remain inadequate despite grass and weed control.

Fertilizers must be used with caution. Overdoses may injure the roots, cause excessive growth, or stimulate rank growth of grass and weeds. Experimental applications of 1/16 - 1/4 lb., (actual nitrogen) per 6-foot tree should be made to determine the least amount per tree needed to obtain desirable color and vigor.

Large scale applications should not be made until sufficient small trials have proven the effectiveness under local conditions.

Straight nitrogen fertilizers have proven more effective and less costly than balanced fertilizers. Commonly used nitrogen fertilizers are urea, ammonium nitrate and ammonium sulphate.

Fertilizer should be scattered evenly under the drip line of the tree in late winter or early spring before the buds have burst. Proper amounts of nitrogen will cause heavy dark green needles after the first growing season.

Increased growth will be only slight during the first growing season but may double during the second and third growing seasons. Therefore, the safest time to apply nitrogen is in the same year that the tree will be harvested. Also, the needle color improvement from using nitrogen begins to drop off during the second growing season after application.

Another use of nitrogen is for stimulating vigor and growth of stunted or thrifty trees on poor sites. Two precautions should be observed in fertilizing younger plantations.

1. Do not fertilize the same year that trees are planted. Roots at this time are easily damaged by even small applications of nitrogen.

2. Use nitrogen sparingly on small trees. Overdoses will burn the roots. Trial applications should be made around the drip lines of a few trees to determine the correct amount to stimulate adequate growth.

H. NUMBER OF YEARS REQUIRED TO GROW A MERCHANTABLE TREE

Rotations for growing true fir Christmas trees will vary with species, site, and intensity of culture. Harvesting is usually carried over a period of three years because all trees do not develop uniformly.

The rotation ages shown below are considered average for intensively managed plantations on Site III lands. The percentage of total cut for each year of an assumed three-year harvesting period is shown.

Percentages of Trees Harvested at Various Plantation Ages

	Number of Growing Seasons					
Species	7	8	9	10	11	Total
	-----Percent of Total Harvest-----					
Grand fir	20	40	40			100
Concolor		10	40	50		100
Noble fir		5	45	50		100
Shasta red fir			5	45	50	100

I. STEP-BY-STEP CULTURAL INSTRUCTIONS

1. After First Growing Season.
Concentrate only on keeping trees alive, healthy and growing.

The only pruning would be removing double leaders. The choice of multiple leaders to save should be based on its vigor, erectness, number of internodal buds, and completeness of terminal buds.

Weed and grass control is essential for good survival.

Watering during prolonged summer drought periods may make the difference between good and poor survival.

The first summer's mortality should be replaced during the regular planting season with the same species originally planted. Replacement stock can be developed in a transplant bed, wherein 5 - 10% of the original planting stock is held.

2. After Second Growing Season.
Same instructions as for "After First Growing Season".

True firs develop slowly and are unlikely to require pruning at this time.

When herbicides are used to control grass and weeds, they should be effective through the second growing season. When cultivation is the chosen method, it should be repeated as often as necessary to leave the ground clean.

Supplementary watering may be continued if necessary. However, it is less

important than during the first year because the roots are becoming established.

Mortality may be replaced from the transplant bed or other sources with trees approximately the same size as those in the plantation. However, persistent mortality spots caused by shallow bedrock sterile soil, or poor drainage, should be replanted to Douglas-fir, shore pine, or some other more tolerant species. Replantings of true firs would likely die for the same reason that the original planting failed.

3. After Third Growing Season.

Weed and grass control should continue. When herbicides are the chosen method, they should be re-applied at the original rates in February or early March.

Most seedlings will not require pruning except for removing multiple leaders. A few exceptionally fast growers may have developed leaders 12" or slightly longer. These may be basal pruned to prevent excessive next year's growth and start a handle. However, in order to prevent overshock and stunting, not more than 1/3 of their live branches should be removed at this time. Trees should be well enough established to discontinue watering.

4. After Fourth Growing Season and Thereafter Until Trees Are Harvested.

Weed and grass control, if by herbicides, should continue every second year. Weed and grass control if formerly by cultivation, should now be replaced by mowing, herbicides, or a combination of mowing between the rows and herbicides under the drip lines. Do not basal prune trees when leaders are less than 12" long. They need their full crowns for adequate growth.

Basal prune, as described above under (3), when leaders are 12 - 15 inches long and no previous basal pruning has been done.

When leaders are 12 - 14 inches long, but trees were previously basal pruned, additional shock treatments are required, as described below:

- a. Complete the basal pruning to increase shock if this were only partially done the previous year.
- b. Basal scar (about 50% scar) if complete basal pruning was accomplished during previous years.

When leaders exceed 14" long, they should be pruned back to 10 - 14" long. These leader pruned trees should also be shocked as follows to prevent future excessive growth:

- a. Complete basal pruning, if this has not already been done.
- b. Basal scar according to need. If leader growth is under 18" and basal pruning is being accomplished at the same time, a 33% scar is probably adequate. If leader growth exceeds 18" and basal pruning was accomplished during previous years, severe scarring up to 75%, should be considered. In extreme cases of excessive leader growth, further shock can be accomplished by root pruning. Remember that leader pruned trees require cutting back their top whorls and fork shearing, as a part of the same operation. Strive for a 50% to 65% crown taper. Taper is defined as the width of a tree expressed by a percentage of its height.

Fork shear any trees that require correction of lopsidedness, excessively wide taper, or imperfect cone-shape.

Fertilize the same year trees are harvested if needle color and vigor needs improvement.

J. CONCLUSION

True firs are in good demand and bring top market prices. Attractive needles, symmetrical branching, and durable foliage are selling advantages. At the same time, true firs are considered the most difficult species to produce in plantations.

Relatively few Northwest growers have produced high quality true fir plantations. The most successful growers have picked suitable planting sites. They have also cultured intensively to attain a cone-shaped tree with adequate density and proper whorl spacing.

Most successful growers try to produce as many natural-shaped, unsheared trees as possible. This type is in greatest demand. However, they practice leader pruning, disbudding, and side shearing to culture any trees with undesirable growth characteristics.

Annual leader growth of about 12 inches is desirable to produce good density in reasonably short rotations. The faster growing trees are shocked by means of basal pruning, basal scarring and root pruning. They are usually employed in the priority listed.

A number of other cultural treatments are also used, either singly or in combination, to improve the quality of plantation-grown trees. Some practices, such as weed, grass, insect, and disease control, may be applied uniformly over large plantation areas. However, most practices are applied according to the individual need of each tree being cultured.

Trial and error experience remains the most important process for developing a skilled grower. It can, however, be unnecessarily costly and time consuming. The purpose of this guide is to point out the pitfalls and successful techniques that have been learned by others over the years.

K. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department Office in Oregon or State Department of Natural Resources Office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of harvesting and marketing information are:

Extension Forestry Specialist
Cooperative Extension Service
Oregon State University
Forestry Building, 205
Corvallis, Oregon 97331

Extension Forestry Specialist
Cooperative Extension Service
College of Agriculture
Washington State University
Johnson Hall, 317-A
Pullman, Washington 99163

Extension Forestry Specialist
State Cooperative Extension Service
Western Washington Research and
Extension Center
Puyallup, Washington 98371

Local offices of the Soil Conservation
Service

U. S. Forest Service
P.O. Box 3623
Portland, Oregon 97208

Northwest Christmas Tree Association.
(The name and address of the current secretary may be obtained by contacting any of the above sources.)

